and supporting the brain with the fingers or a bit of cotton. Then transfer to the bowl of alcohol as above directed, and the increase in weight will represent, with approximate accuracy, the weight of the brain.

REMOVAL OF THE PIA.—This is most easily accomplished at the time of the removal of the brain to the stronger alcohol. At any subsequent period the pia is apt to be more firmly adherent. If the brain has been allowed to dry at all during its removal from the skull, the pia comes off with great difficulty.

*Instruments and materials.*—Forceps; fine forceps; medium scissors; wetting-bottle of 15 p. c. glycerine; cotton thoroughly wet with water, and so moulded as to form a sort of shallow cup in which the brain may rest without danger of rolling off.

Place the brain upon the cotton, and wet it with the glycerine. Then let it rest upon its ventral side, and grasp it in the cotton, firmly yet gently. Grasp with the forceps the fold of *pia* which occupies any one of the fissures, especially at the point of forking or junction with another fissure, and pull along the line of the fissure. Usually the fold of pia will come out easily, and with it will be removed some of the pia covering the free surface of the gyri between it and the adjoining fissures. Proceed thus until the pia has been removed from the dorsal and lateral aspects of the hemispheres. Avoid pulling across the line of the fissures. The larger forceps are easier to work with, and less apt to puncture the brain; but the fine forceps are sometimes required for the removal of the pia from the bottom of a deep fissure. The caudal surface of the hemispheres may be reached by slightly ventriducting the cerebellum. The mesal pia can only be removed close to the margins of the hemispheres.

On one side, preferably that on which the *N. opticus* was cut shorter, raise the mass of nerves formed by the divisions of the *N. trigeminus* and *N. abducens*, by its lateral border, and cut with the scissors the *N. oculomotorius* which holds the mesial border close to the brain. This will permit the mass to be turned caudad so as to expose the course of the slender *N. trochlearis* which emerges from between the hemispheres and the cerebellum. It also permits the removal of the pia from the region just laterad of the hypophysis. Grasp the pia on the ventrimeson just caudad of the *Bulbi olf.*, and pull caudad so as to remove it as far as the chiasma, taking care not to tear the delicate *terma* just dorsad of the chiasma. Then remove the pia from the olfactory tracts.

In removing the pia from the medulla the position of the nerve roots should be constantly kept in mind, and the traction should be laterad and cephalad. One of the most difficult things is to preserve uninjured the series of roots of the *N. hypoglossalis*, for their connection with the pia seems to be closer than with the medulla. Sometimes it may be necessary to let the brain be wholly below the surface of water or alcohol so as to float the roots out, and render them more apparent.

As suggested on a previous page, it is often as well to leave the roots longer on one side than the other, but the choice may be determined mainly by the degree of success in the various operations which have been described.

If desired, later numbers of "SCIENCE" will contain directions for the general dissection of the brain. Meantime, it would be well for the student to make outline drawings of the brain he has prepared, especially of its base. Most of the principal features of this surface can be identified from the figure of the corresponding surface of the human brain to be found in any good Human Anatomy. The drawing should be enlarged two diameters, and the brain should be kept wet with the glycerine mixture, while it is out of the alcohol.

LIST OF WORKS AND PAPERS REFERRED TO.

*Chauveau, A.*—A. Traité d Anatomie Comparée des Animaux Domestiques. 2d edition, O., Paris, 1871.

*Dalton, J. C.*—[2]. Centres of Vision in the Cerebral Hemispheres. *Med. Record*, March 26, 1881. 337-339, 2 figures.

*Flower, W. H.*— . Observations on the posterior lobes of the cerebrum of the Quadrumana, with a description of the brain of a Galago. Phil. Trans., 1862, 185-201; 2 plates.

*Foster & Langley.*—A. A Course of Elementary Instruction in Practical Physiology. 3 edition, D., pp. 276, London, 1878.

*Sanderson, J. B.* (Editor).—A. Hand-Book for the Physiological Laboratory. 8vo., text, pp. 585; Atlas, 123 plates. Phil. 1873. Reprint of the English edition with slightly different paging.

*Straus-Durckheim, H.*—B. Traité Pratique et Theoretique d'Anatomie Comparative, Comprenant l'Art de Dissequer les Animaux de toutes les Classes et les Moyens de Conserver les Piéces Anatomiques. 2 vols., D. 870 pages, 4 plates, Paris, 1842.

*Wilder, B. G.*—[9]. A Partial Revision of Anatomical Nomenclature, with Especial Reference to that of the Brain. "SCIENCE," 11, 122-126 and 133-138, March 19 and 26, 1881.

## ATOMS AND MONADS, THEIR METAPHYSICAL DEVELOPMENT.

BY DR. DIODATO BORRELLI.

(Translated from the Italian by the Marchioness Clara Lanza.)

In previous chapters of this work [1] it has been shown that the whole product of our psychological activity typifies a purely metaphysical world. It has likewise been seen, that the vast compound of forms by means of which exterior nature is represented to us, is not an extrinsic reality, but merely our own impressions, the result of slow and unconscious practice. A minute physio-psychological analysis leads us to this necessary conclusion. Colors are mere modifications, induced in certain groups of ganglion and cephalic cells by a stimulus which acts upon the organs of sight. Sounds are another form of cellular modification determined by a different kind of stimulus. Weight and resistance are phenomena of muscular sense. Form and size, synthetic relations, and therefore purely subjective phenomena. All the complex qualities by means of which physics are able to recognize different bodies, are nothing more than our own determinations. From this we may properly conclude that body and matter are not extrinsic realities, but a complication of modifications produced within us by exterior impulses.

Our world is therefore purely phenomenal, and not a reality. Herbart reasonably maintains that the first moment of research must necessarily be one of doubt, or scepticism, which is degraded or elevated in proportion as the uncertainty concerns things as they seem to us, or whether it relates to existence itself. Does the reality exist? This is the first question which presents itself to the philosopher. And if it does exist, what constitutes it and the consecutive research? "We cannot deny the reality," says Herbart, "because, to do so, is to remove all possibillity of the phenomenal world before mentioned. Sensations, representations and thoughts would be completely annulled."

This phenomenal world, resulting from the data of experience, is that which induces us to admit the existence of positivism. But these data do not constitute real existence, because they are not self-subsisting, but depend upon something else. That is to say, they exist in something else and by means of something else. *Actual existence* does not admit of either relation or dependence, it is based upon itself, and is, therefore, an absolute con-

[1] Borrelli. *Vita E Natura. Studii sui temi più importanti del Moderno Naturalismo.* Naples, 1880.

dition to the full comprehension of which we cannot attain, although we cannot fail to recognize it. The positive is, therefore, something to which this absolute existence attaches itself—it is in fact, a quality.

According to Spencer,[2] positiveness is nothing more than *persistence in the consciousness;* "unconditional persistence, such as the mental perception of space, or conditional, such as the intuition of a body we hold in the hand. That which establishes the persistence is really what we call positiveness, of which, (although we have demonstrated that the positive within our own consciousnsss is not objective) we, nevertheless, form an indefinite idea as being something which persists absolutely, in spite of all change of mode, form or appearance."

Spencer's definition, however, is in some respects open to criticism. First of all, if by consciousness, individual consciousness is to be understood, can anything persist which is merely an illusion without any definite existence? This can only happen under certain pathological conditionns of the mind. But there is still another point. Persistence in the consciousness is certainly a relation, because no thought can be produced without a relation, and even Spencer affirms this when he says; "We think relatively, every thought is based upon a relation."

However, according to Herbart, one of the principal conditions of absolute reality, is to be free from everything pertaining to dependence or relation. To avoid confusion, we must give more than one signification to the word positiveness. To begin with, we cannot ignore a *relative positiveness* which comprises all the conscious conditions of our being, and the famous sentence "*cogito, ergo sum,*" is in itself a peremptory demonstration of it. Sensations, representations, sentiments and all other familiar modifications are embodied in such positiveness. Whether they correspond to an objective effect or not: whether they are illusions of a diseased mind, or normal representations, is of little consequence. We know that they exist in our consciousness, and that is sufficient, inasmuch as they typify a real function.

We cannot say as much for objective or absolute positiveness. In regard to this, the experience of our senses teaches us nothing. We only know that it does not correspond to our individual sensations and that it differs from them essentially. In all our relations with the exterior world there is nevertheless a common and constant condition—an inexplicable something which acts upon our organs of sense and determnes the inward modifications. If, however, we rob Nature of our complex determinations, we leave nothing remaining but *stimulus* or *action*, which works upon us incessantly. The idea of objective or cosmic positiveness, originating from the da'a of experience, presents to us a conception of force or energy, combined with continual action. Absolute positiveness we can only understand as something corresponding to *permanent acitvity*.

The most ancient philosophers of Greece and India made extensive speculations as to what this natural force or activity might be, which operates in such manifold ways upon our senses and creates in us the most stupendous and varied phenomena. Indeed, human reason in Ionian, Pythagorean and Eleatic schools, seems to have been directed solely upon Nature under its various aspects.

According to Thales, water is the first general principle from which all other things are derived. In Anaximander of Miletus, a more condensed cosmological conception appears concerning the universe as being constructed out of *primitive matter*, which he called fundamental principle—an eternal, infinite, indefinite basis, from which everything originates and to which everything in the course of time, returns. This principle is not, as Aristotle appears to think, a compound which upon separation resolves itself later into particular forms. It seems easier to believe that the specification could only occur under some peculiar influence.[3]

We may well be astonished when we consider that six centuries ago a conception concerning the universe arose, which intimately resembles our modern cosmology. And our wonder is increased ten-fold when we see Anaximander produce from his fundamental principle the original antithesis of heat and cold by means of an inherent and eternal movement of the substance.[4]

According to Anaximanes, *Air* is the first general principle from which everything is produced by means of the double process of condensation and rarefaction. This theory should not appear strange to our modern mechanical school, according to which, particular forms of ethereal atoms are diffused throughout sidereal space, from which chemical atoms, and, consequently, all ulterior bodies are produced.

While the Ionian school deals principally with the sensible qualities of bodies, it aims more directly towards their inward substance. But we see in that of Pythagoras a new tendency, an increased abstraction. Paying but little attention to Nature, which is unknown to existence, he turns to consider order and quality, which are, indeed, realities. Numbers are the principle of all things; the Universe is only measure and harmony. Our quantitative relations, dimension, extension, form, distance, etc., are impossible without the aid of numbers, and therefore numbers are the first principle in all things, as they determine the order in which everything presents itself. Without stopping to discuss with Zeller as to whether the Pythagorean numbers are the substance or model of sensible things, we must particularly note that the idea of order and numbers is chiefly important in our modern conception of the Universe. If Nature really consists of but a single substance of various formations from whose elementary parts the specification of individual bodies is produced, it is natural to suppose that the true essence of all things by which they are determined, cannot be the indefinite cosmic principle, but a special disposition, which assumes its elements and the number in which they unite. *Numbers and disposition* form, as we shall see, the basis upon which modern chemistry rests.

With the Eleatic school which arose from a conception of *unity* and *immovability*, exaggerated to such an extent as to lead Zeno to a paradoxical denial of all motion, we come to Heraclitus, who, in direct opposition to the Eleatic school, speaks of perpetual flux and movement. The permanence of existence is merely an illusion. Positiveness may be compared to a river which disappears as it rises, and into whose waters, consequently, we can plunge but once. Heraclitus affirms that nothing remains equal to itself, that everything increases, diminishes, and finally dissolving, passes into other forms. Hence, from life to death, and from death to life again. The appearance and disappearance of these forms is, therefore, the perpetual vicissitude of the universe. In this stupendous doctrine we have the conception of future existence, which is nothing more than the harmonious blending of adverse tendencies. And in it we think to perceive the germs of the future theory of evolution. But it contains something else also. According to Heraclitus *fire* symbolizes the law of vicissitude. This is a profound doctrine which demonstrates to modern theories that no new formation or division of elementary bodies is possible without a corresponding modification in the inward action from which thermal phenomena are derived.

In the four roots of all things—fire, air, water and earth—there is first of all connection with the *sphere* and later a division. Upon this blending and separation depends the source and dissolution of all particular forms.

[2] Herbert Spencer. *First Principles*. 1871.

[3] Zeller, quoted by Fiorentino. *Manuale di Storia della Filosofia*, Naples, 1879.

[4] Schwegler. *Geschichte der philosophie.*

In Empedocles we find for the first time a confused perception of *attraction* and *resistance* in the sympathy and conflict which are the determining causes of the union and disunion of the elements.

Up to this time we have an irreconcilable antithesis between the Eleatic conception and that of Heraclitus. On one side, by exceeding the data of experience and elevating to the highest degree abstracts of material things, we find existence robbed of all determination and unchangeable. On the other, we have existence and non-existence bound together by means of the Future, from which springs the change and perpetual vicissitude of all things. But there is no fixed law for the Future of Heraclitus; it is merely the result of experience, nothing more. Why, therefore, does existence change? Why are forms produced only to be again dissolved into something else? An attempted explanation was given, as we have seen by Empedocles; sympathy and resistance attract and repulse the four radicals of all things, and all forms are produced by the attraction which the repulsion afterward disunites and destroys. This is a profound conception, but yet somewhat obscure and undecided.

It was the *Atomical* school which took gigantic strides along this path, finally reaching those massive theories which even to-day we must look upon with admiration. Its founders were Lucippus and Democritus,but the latter is undoubtedly the most celebrated. We will go over the most important points in his doctrine, as they are related by Fiorentino.

"Existence is not a unity, but a combination and an infinite one, composed of many minute and invisible bodies which move about in space, unite and produce life, then separate, and cause death. They are capable of union and disunion, but never of change, and just as they are in the beginning, so they will always remain.

"We can distinguish in atoms form, order and position which are the primitive qualities which serve to produce others. All atoms are not equal; all have a downward tendency, but the lighter rise above the heavier producing a rotatory motion which extends and forms bodies."

Atoms, moreover, are impenetrable, and as units cannot be divided. They are consequently distinct one from the other, well defined and unconfused. This necessitates the interposition of something which tends to keep them separate. It can be nothing more than the *opposite* of the mass, vacuum, which causes interceding intervals between the atoms and holds them apart. Without vacuum, no motion could be possible, as the mass can receive nothing more in itself, or be augmented in any way, because this can only be obtained by the introduction of new atoms in the vacuum. We have, therefore, two contending agencies—existence (atoms) and non-existence (space), which go to represent objective positiveness. The final and most important of atomic theories bears the stamp of unconscious and unintelligible *natural necessity*. Motion can be determined by no cause. It is as eternal as the atom itself and is a part of its nature. It is easy to understand therefore, however far it may depart from the truth, the opinion of those followers of Democritus who attribute the origin of the world to chance.

By the atomical theory we have reconciled therefore, the unchangeableness of existence with the perpetual transformation of things; transformations which have nothing to do with the substance, but which spring from special arrangements of the atoms determined by motion. We shall shortly see how the fundamental doctrines of the atomical school have been reproduced in our modern mechanical one after a lapse of four centuries.

The Grecian mind was not satisfied with the mechanical explanation of future existence. We consequently see brought to light for the first time by Anaxagoras, an immaterial principle *Nous*—an intelligence apart from all matter, maker of the world. In short, an agent with a definite purpose. This intelligence, although motionless itself, is the cause of movement, and the formation of the *panspermia* or *omeomeria*, as Aristotle calls it, is the result of its action. This is the systematic and beautiful origin of the world.[5]

This intelligence, however, is not a personal god, because it possesses no action in itself and its operation develops solely in the motion and order of matter. Plato and Aristotle are quite right when they blame Anaxagoras for holding to the mechanical doctrine while having an instinctive perception of the final cause.

The *Nous* of Anaxagoras, as Schwegler has observed, closes the period of anti-Socratic realism, that is to say the conception of natural positiveness as represented by ancient Grecian philosophy. Anaxagoras embraced the principles belonging to the preceding schools which he attempted to reconcile, but he made apparent for the first time an *ideal* principle, which being accepted by Socrates, afterwards expressed the new and adverse current of Grecian thought.

Atomism reappeared with Epicurus, not presenting, however, any novel determination, except that the atoms did not all descend in a direct line giving rise to a whirling motion, as Democritus affirms, but proceeded each separately in its own way guided by a kind of free will.

Throughout the long period of ideal speculation which succeeded ancient Grecian philosophy, investigation in regard to cosmic positiveness being looked upon as a matter of secondary importance or else neglected altogether, naturally made no progress whatever Thus we come to the Sixteenth century, during which a single voice in England was raised to deplore the false road upon which human thought had traveled for so long, agitated and confused by empty and useless discussions. Logic seemed to aim towards the "strengthening of error rather than the search for truth." "And this," said Bacon, "can proceed from nothing but the fact that scientific research is alienated from its true source—nature and experience—to which it must return if anything is to be achieved." Although many errors crept into the facts accumulated by Bacon among his perceptions of great truths, he, nevertheless, rendered an immense service to science by recalling it to experiment and to the inductive method. About the same time, a great Italian, Galileo, not only proclaimed the system, but applied it, gathering much more fruit from his enterprise than did the English philosopher.

This was one of the grandest moments known to the human mind. In this period, which we call the Renaissance, while man, no longer satisfied with the narrow boundaries of the old world, discovered new paths while in search of other lands, human conscience oppressed by centuries of overbearing slavery advanced towards reformation. Then speculation, shattering its scholastic fetters, opened a new field for research, and resolved to cultivate it by fresh methods. Later we shall see the abundant fruit which grew, not so much from the field of abstract speculation as from that of natural investigation.

René des Cartes here broke in with past traditions, endeavored to make the research over again from the beginning, and commenced to exclude all supposition and to entertain doubts about everything. But the new structure of facts which he built upon Thought was precisely the contrary of his method. Positiveness according to des Cartes is represented by three substances—God, Mind and Matter. Thought is the attribute and essence of mind; extension is the attribute of matter. Here, then, is cosmic positiveness reduced to nothing more than *expanse*, while in our opinion it is the very opposite. Expanse is merely a relation, and it annuls the absolute condition of existence reducing it to a simple *rapport*.

[5] The panspermic theory affirms that the germs or elements of all things exist in the earth, and only require a particular combination of circumstances to bring them forth.—TRANSLATOR.

In the monadology of Leibnitz, we find a reversion to atomism under an ideal form. He considers the substance of the universe as an active force, represented by monads. These, after the manner of atoms, are a distinct unity, unchangeable and indestructible. Contrary, however, to atoms, which do not present any qualifying diversity in themselves, monads are distinguishable one from the other, each one personating, as it were, a distinct form. Moreover, atoms being capable of expansion, can be regarded as separable, but monads cannot, because they are metaphysical conditions. And inasmuch as metaphysical conditions, no matter how they unite, can never go beyond a certain limit, Leibnitz denies the objective reality of space, and looks upon it as a kind of co-existence.

But the most important part of his doctrine is the conception he places upon the action of monads. Each one has its peculiar representation apart from the other monads and consequently, the universe. All the ulterior developments of the latter are therein portrayed, so that in monads we may read the future. Such representative power is not the same in all of them, however. Some, monads of the lowest degree, have a confused representation which may be compared to vertigo or dreamless sleep; a condition in which representations are not wanting, but being neutralized cannot attain consciousness. These lower orders of monads represent the first link belonging to the chain of existence, which is called inorganic nature, and the bodies resulting from them may be likened to a fish pond whose elements are alive while it is not.

Occupying a higher grade, in the vegetable kingdom, are monads in which representation acts as a formative vital force, but always totally unconscious. Higher still, in the animal world, monad life rises to sensations and memory, and finally to reason and reflex action. However, let us repeat, in order that it may be well understood, that the representative contents of the various orders of monads do not differ, because each one, like God, reflects the entire universe *(parvo in suo genere deus)*. The difference lies solely in the clearness and perfection of the representations.

We will not linger here, however, that we may slowly follow the ideas of Leibnitz in regard to the relations existing between God and monads, or between them and the soul by means of pre-established harmony. We will merely observe that if we remove from monadology all the purely imaginary elements with which it overflows, there still remains something both novel and important which is not to be met with in old atomical theories. This novel determination consists in a peculiar active force which each monad possesses *internally*. It is a prior intuition of *pampsichism* which being enriched moreover by positive facts, can lead the way perhaps, to the greatest reconciliation of which the human mind is capable.

We find another reversion to atomism in the metaphysics of John Frederick Herbart. We have already seen his conception of absolute positiveness. However, experience receives many suggestions from the phenomenal world, which is composed of manifold appearances. And as every appearance insinuates a determined Reality, the latter must be considered as a compound of several single entities or monads, each one posessing different qualities. The individual groups of these monads are those which, working upon our senses, there produce the representation of definite objects. We find a vast difference between Herbart's conception and that of Hegel; while the former considers Nature as a plurality, the latter conceives it to be a unity. To one, absolute positiveness is the Ideal, while for the other, on the contrary, it is Reality.

But how can we reconcile the absolute condition of the Real, the peculiar conservation of monads with the phenomenon of mutation. Herbart has recourse to *accidental perceptions* and *intelligible space*. By accidental perceptions, we mean the manifold relations which can proceed from a single conception, according as it may be compared with others, but, nevertheless, remaining always unchanged. Thus, for example, a straight line can be considered as a radius or as a tangent without changing its position, just as a sound can be harmonious or discordant, according to the relation it bears towards other tones. In the same way, in the grouping of various qualities of monads, while on one side there is no change, on the other there is a very perceptible one. By means of *intelligible space* we may consider existence either as a complex form or as an individuality.

This theory, which in some ways closely resembles the old atomic dogma, is far removed from it, inasmuch as the monad or atom, according to Herbart, does not possess an impenetrable character.

Looked at from a mathematical point of view, several monads may coincide perfectly one with the other. Between the monad of Leibnitz and that of Herbart, there is also a noteworthy difference, because the former considers the *internal condition* as original and individual; while with the latter it is wanting, if we consider a single monad, but develops with the reciprocal relations between the monads.

We will finish with Herbart, our brief explanation of atomism revealed upon a field of pure metaphysical speculation. On the other hand, a new doctrine arises, an experimental one, from which we shall see produced an atomic theory, which is not the work of more or less arbitrary deductions, but the slow result and synthesis of a multitude of positive facts.

## ASTRONOMY.

### SPECTRUM OF "LALANDE 13412."

We are indebted to Prof. Pickering for the following note upon some observations recently made at Harvard College Observatory:

"The star *Lalande* 13412 has a very curious spectrum. It belongs to the same class as *Oeltzen* 17681 and the three stars in *Cygnus* having bright lines. Besides the yellow and blue bands, it has a marked line in the green, which is faint, if not wanting, in the other stars. It is also about a magnitude brighter than either of them, so that it is the only object of the kind within reach of small telescopes. Professor Young found *Oeltzen* 17681 difficult with 9-inches aperture, while I discovered this object with 4-inches aperture. The position for 1880 is:

R. A. $6^h$. $49.3^m$.
Dec. $-23°$ 47.′

or about 15′ north of *o Canis Majoris*. In winter this star is conveniently observed when all the other stars of this class are below the horizon.

The same evening I found that the spectrum of $a^2$ *Puppis* is banded. As the declination of this star is $-44\frac{1}{2}°$, this is probably the most southern object ever usefully observed here. Its altitude at the time of observation was only about 2°!"

The Transit of Venus Commission established by the French Academy of Sciences, has resumed its labors under the presidency of M. Dumas. A credit has been given by the Government for constructing new refractors. Not less than twelve are now building, to be used on the several stations which have been already selected, and will be ready by the end of the year. The heads of the scientific missions will soon be appointed, as well as their staff. The greater number of instruments built for the 1874 transit has been disposed of to several public institutions.—*Nature*.

W. C. W.

WASHINGTON, D. C., April 6, 1881.